

COMMONWEALTH OF AUSTRALIA

PATENT SPECIFICATION

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Drawings (2 sheets) attached.

COMPLETE SPECIFICATION.

"Improvements in respirator."

We, Willson Products, Inc., a corporation organized under the laws of the Commonwealth of Pennsylvania, of Second and Washington Streets, Reading, County of Berks, Commonwealth of Pennsylvania, United States of America, hereby declare this invention and the manner in which it is to be performed, to be fully described and ascertained in and by the following statement:—

The present invention relates to improvements in a respirator of the type which is held in sealing engagement with the face of the wearer along a contour which surrounds the nose, mouth and chin and adapted to give protection against dusts, mists, fumes, gases and vapors of various kinds. An outstanding disadvantage of common designs of the above type of respirator is that they are not comfortable to wear. Therefore, even after they are worn a relatively short time, substantial discomfort results which often-times impels the wearer to remove the respirator and thereby expose himself to the

deleterious effects of breathing dust and noxious fumes.

A further disadvantage of commonly used types of respirators is that they are somewhat complicated in construction, requiring special stiffening material, such as metal wire, bands or straps,—furthermore, they conform to the features of the face only when worn low on the nose, and are adaptable to fit a limited number of nose bridge or facial contours, thus requiring the stocking of a number of different sized respirators. Still another outstanding disadvantage of commonly used types of respirators is that the inhalation disc-type valve which is generally fastened at the center is activated into vibration around its peripheral edge by the voice of the wearer to such an extent as to distort and mute the voice into an incoherent jumble of words. Furthermore, replaceable filter units which are detachably secured to the face piece generally have threaded connectors which often involve difficulty in engagement before rotating and require a

considerable number of rotations before a dust-tight connection is secured. Therefore, it is often necessary to remove the respirator in order to replace filter units.

An object of the present invention is to provide a novel respirator which is devoid of the above named disadvantages of common types of respirators.

A further object of the invention is to provide a respirator having a face piece which is extremely comfortable yet snug fitting, self-adjusting, and providing floating, cushioned engagement with the face to provide a gas-tight seal therewith,—also which is adapted to fit a large variety of facial contours, especially over the critical nose region.

A further object of the invention is to provide a self-aligning headband for a respirator which will create a tight fit with pressure adjustability around the entire peripheral contact edge so that the wearer can place straps to suit above the ears and across the top of the head, thereby concentrating most of pressure underneath the large chin area and reducing the pressure over the nasal region or below the ears, thus providing an extremely comfortable yet very efficient respirator capable of being worn for extended periods of time with a minimum of discomfort.

A still further object of the invention is to provide a respirator having improved dual, negative acting, air inlet valves having lower inhalation resistance and which eliminate distortion and muting of the voice of the wearer and enable others to clearly understand what he is saying while wearing the respirator.

A still further object of the invention is to provide in a respirator, an improved connector which enables relatively easier and quicker attachment or removal of a replaceable filter unit or cartridge, even while the respirator is being worn.

Other objects and advantages of the present invention will become apparent from a study of the following description, taken with the accompanying drawings wherein:

Fig. 1 is a front elevational view of a respirator embodying the principles of the present invention, and showing one of the

filter cartridges removed from its support on the respirator;

Fig. 2 is a front elevational view of the face piece shown in Fig. 1 and more clearly illustrating the substantially triangular or pear shape and other features thereof;

Fig. 3 is a vertical sectional view taken along line III-III of Fig. 2 and which more clearly shows the inner roll contour line and specifically, the variations in wall thickness in and around the parting line as well as along the frontal section and plateau;

Fig. 4 is a horizontal sectional view taken along line IV-IV of Fig. 2 and showing the general shape of the lower half of the face piece;

Fig. 5 is an enlarged sectional view taken along line V-V of Fig. 1, and showing the design of the quick-clip incline plane seal and the inhalation port and valve;

Fig. 6 is a vertical sectional view of a filter unit having a flat disc type of filter;

Fig. 7 is a vertical sectional view of a filter unit having an accordion pleated filter;

Fig. 8 is a rear elevational view of the respirator illustrated in Fig. 1 showing the inner roll peripheral contour; and the position and shape of the improved inhalation valves, and

Figs. 9a and 9b are plan views of two component headband parts which form the pressure adjustable self-aligning headband shown in Fig. 1.

Referring more particularly to Fig. 1 of the drawings which shows a respirator involving the principles of the present invention, numeral 1 denotes a face piece which is preferably molded of any suitable resilient material and which is cup-shaped with a pear-shaped contour along the mouth portion. Said material may be rubber. Face piece 1 is designed to cover the nose, mouth and chin of the wearer and adapted for air excluding contact between the face-contacting periphery thereof and the face of the wearer. Face piece 1 has a top convex portion 2 and two side concave portions 3 along its contour which are adapted to surround the nose. Attached to each of the lower lobes of face piece 1 is a readily detachable and replaceable fil-

ter cartridge unit denoted generally by the numeral 4. The lowermost portion of the face piece surrounds the chin and adjacent thereto is an exhalation valve 5. The respirator is held against the face of the wearer by means of headband 43-44 which is attachably secured to the filter unit supports.

An important feature of the invention resides in the specific shaping of the face piece 1, particularly along the face-contacting portion thereof, which is best illustrated in Figs. 2, 3 and 4, which shaping provides amazing improvement in comfort and enables the wearing of a respirator for a long period of time before any discomfort is apparent, considerably longer than possible with common types of respirators. As shown more clearly in Figs. 2, 3 and 4, face piece 1 has an inwardly curved, face-contacting edge portion 6 which, at the nasal section, extends of the order of  $3/16$  inch outwardly from a parting line 7 denoted by dash lines and gradually increases to a distance of the order  $5/16$  inch from the parting line along the cheek-contacting edge portions for providing air excluding contact with the varying facial contours. Edge portion 6 extends substantially along a flat plane principally at the nose-contacting portion. It has been found by experiment that by forming the face-contacting edge portion 6 along a flat plane instead of having it extending inwardly at the nose portion as is commonly done, the face piece is more adaptable to fit varying nasal and facial contours and may be worn either high or low on the nose with equally efficient face-contacting, air-excluding engagement, and without discomfort. The inwardly turned face-contacting edge portion 6 is greatly reduced in thickness beginning from the parting line and extending along its entire curvature, being approximately 0.025 inch in thickness around the nasal region and increasing abruptly in thickness at the parting line 7. From parting line 7 the thickness is doubled along side wall portions 8 and finally increases to about 0.125 inch along the remainder of the side wall portions and the front plateau 9. Thus the portions 8 and 9 will give sufficient rigidity

to the face piece so that it will retain a given shape without stiffening elements. The abruptly thinner intumed marginal portion 6, because of its thinness, will be extremely yieldable and collapsible so as to form a cushion-like, air excluding contact with the face which will enable it to mold itself to varying facial features encountered with the exertion of very slight compression in order to give an air-tight seal and to eliminate noticeable pressure points, particularly over the critical nasal region. At this region, the extreme thinness of intumed edge portion 6 together with the disposition of the marginal portion substantially along a flat plane allows the respirator to be worn either high or low on the nose without the loss of the air-tight seal. Also, greatly increased comfort without the sacrifice of efficiency is provided as well as increase in the adaptable fitting range to a greater variety of facial contours.

At the base of face piece 1 there is provided an exhalation valve 5 including an outlet aperture 11 which is closed by a positive acting, air outlet valve 12 which consists of a thin rubber disc secured centrally thereof to a substantially wheel-shaped portion 1a of the face piece, including a plurality of apertures extending between radially extending spoke portions radiating from the hub-like portion and terminating in a rim portion having a circumferential groove for providing a detachable, airtight fit therewith (see Fig. 3).

Extending through each of the cheek surrounding portions of the face piece is an air-inlet aperture 13 surrounded by a grommet 14.

As will appear more clearly in Fig. 1, grommets 14 serve as means for securing the base portions of a pair of shallow cup-shaped filter supports or holders 15 made of plastic or light metal, such as aluminum, or any other suitable material. A plurality of radially inwardly extending flanges 16 are integrally formed on the mouth portion of the cup-shaped support 15. Contained within the cup-shaped support is an annular rubber gasket 20. Thus the filter support assembly described enables quick attachment or detachment of

a replaceable filter cartridge unit, such as 17, or a replaceable filter unit of the type shown either in Fig. 6, employing a filter disc, or in Fig. 7, employing an accordion-shaped hollow filter pad.

As will appear more clearly in Fig. 1, the filter cartridge 17 which is shown removed from its holder comprises a hollow cylindrical plastic or metal case 18 having three (or more) integrally formed, radially outwardly extending flanges 19 which are adapted to cooperate with the radially inwardly extending flanges 16 of the filter holder 15. Each flange 19 has one end 19a which is very thin or substantially pointed and which gradually increases in thickness, forming an inclined plane until reaching a point 19b after which it levels off and retains the same thickness or height until it reaches an abruptly upwardly extending raised or stop portion 19c at the other end thereof. Thus the three integral flanges 19 of the cartridge may be quickly inserted between flanges 16 of the holder 15 and the cartridge is then turned clockwise so that the inclined portions of the flanges slide underneath flanges 16 to provide a wedging action, thereby progressively clamping flanges 19 against the rubber gasket 20 seated in the filter holder until the stop portions 19c of the flanges come into contact with flanges 16, or until the rotation has been forcibly terminated. The compression between the flat or bottom surfaces of the flanges 19, which are flush with the inner edge of case 18, and gasket is sufficient to provide an air-excluding contact to prevent contaminated influent air from being drawn through the sealed joint. It will be seen that this improved, quick-clip, inclined plane connection requires only 1/4 turn of the filter cartridge to provide an air-tight seal as compared to threaded connectors commonly used on most respirators which usually require at least 2-1/2 revolutions to tighten the seal. Also, the operation of attaching or removing the filter cartridge is simple and may be done while the respirator is being worn and without the difficulty of initial threading of the connector as is sometimes encountered in screw threaded connectors.

The details of the replaceable filter cartridge 17 are more clearly shown in Fig. 5

wherein it will be seen that the hollow cylindrical case 18 encloses a chemical charge 24 which is retained by disc-shaped filter pads 25 and 26 of felt or similar material and against which there are laid screens 27 and 28 of small mesh. The outer edge of the case 18 is rolled inwardly to compress the screens and seal the chemical charge against the integral circular ledge 29 of the case 18 which extends radially inwardly along substantially the same plane in which radially outwardly extending flanges 19 are located.

Instead of using a replaceable filter cartridge 17 as shown in Fig. 1, it will be noted that the filter supports or holders 15 are adaptable to engage and support other types of filter units with equal facility, such as the filter disc unit shown in Fig. 6 or the accordion or pleated hollow filter unit shown in Fig. 7, since both of these units are provided with radially outwardly extending flanges, similar to 19 of cartridge unit 17, therefore will be attachable in the same manner.

Referring more particularly to Fig. 6, it will be noted that the bottom of cup-shaped support 15 is provided with a circular ledge 15a at the periphery thereof. A cup-shaped metal or plastic shell or cover 31 is employed as a filter-sealing retainer. Cover 31 is relatively shallow in depth and is performed on its face portion by a plurality of holes. It is provided with an inwardly extending circular edge portion 32 as well as three outwardly extending flange portions 33 which are similar to flange portions 19 of the cartridge 17. As the cover 31 is placed on filter holder 15 and turned clockwise about 1/4 turn, the inclined portions of flanges 33 will slide underneath flanges 16 of the holder and cause progressively tighter engagement and sandwich a dish-shaped filter pad 34 between the cover 31 and the holder 15.

Fig. 7 shows a structure very similar to that of Fig. 6, but wherein a hollow pleated or accordion type of filter pad 35 is provided and wherein the ring-shaped filter pad portion 35a is clamped between a perforated cover 36 and filter cup 15 by means of flanges 37 integrally formed on the marginal edge portion of the cover 36 which are similar in construction to flanges 19 in

Fig. 1 and are adapted to be guided by the inwardly extending flanges 16 of holder 15.

Thus various types of filter units may be used interchangeably on the respirator.

Another important feature of the invention resides in the design of the inhalation valve with the object of reducing inhalation resistance as well as to eliminate or minimize voice distortion. As will appear more clearly from Figs. 5 and 8, the metal grommets 14 which secure the filter holder 15 to the face piece 1 provide inhalation ports or holes therethrough. On the inner side of the face piece and covering these holes there are provided a pair of substantially elliptical, thin sheet rubber, negative acting valves 38 whose central portions serve to flex inwardly toward the face of the wearer upon inhalation, permitting incoming filtered air to enter the face piece through the inhalation ports, and which will flex outwardly when exhaling, thereby closing the inhalation ports by seating on the grommets 14. This will prevent exhaled air from entering the filter unit which would otherwise impair the efficiency of the filter. Each of the valves 38 has two holes 38a located on diametrically opposite portions of the major axis thereof and located about 1/8 inch inwardly from each edge for securing the valves to lugs 39 which are struck out from and integral with face piece 1. Alternatively a separate substantially annular plate (not shown) carrying lugs 39 may be clamped inside of face piece 1 and held in place by the inward turned edge of grommet 14. Thus valves 38 are retained in a loose fitting position while covering the inner rim of grommets 14. With such design, inhalation resistance is considerably reduced,—furthermore, there is eliminated the resonating vibration so often created with a cylindrical, center-secured type of valve as commonly used by virtue of the vibration around its peripheral edge initiated by the voice of the wearer which causes distortion and muting of the voice into an incoherent jumble of words.

At the lower part of the face piece facing downwardly and away from the plane of the marginal edge portion 6, there is provided an exhalation port or outlet aperture

11 on which is mounted an exhalation or outlet valve 12 substantially disc-like and umbrella shaped and having a stud 41 for securing it centrally to the hub portion of the valve seat so that when air is exhaled the disc diaphragm valve 12 will flex outwardly at its periphery, thereby uncovering the opening 11 and allowing expired air to escape. In the pause between inhalation and exhalation, valve 12 will return to its normal position. On inhalation, valve 12 will be drawn tightly over the valve seat opening so as to form an air excluding contact between the valve and seat and prevent contaminated air from leaking into the face piece 1.

Figs. 9a and 9b show an improved self-aligning, head strap assembly, comprising two halves 43 and 44. Half portion 43 has a pivoting elastic strap 45 crossing through a buckle slide 46 and having snap buttons 47 at its ends which are adapted to be snapped to either pair of snap studs 48 or 49 located on the back of filter holders 15 as shown more clearly in Fig. 8. A single elastic strap connector 50 has one end secured to the other side of the buckle slide 46 and its other end fastened to a set hook 51 which is adapted to engage an adjustable slide and eye 52. Slide 52 may be slid and adjusted along one end of a single elastic strap 53 whose other end is secured to buckle slide 54. Another pivoting elastic strap 56 is slid through the other side of buckle slide 54 and provided at the ends thereof with snap buttons 57 which are adapted to snap onto the remaining pair of snap studs 48 or 49 shown in Fig. 8. Thus, when the headband is adjusted so as to tightly hold the face piece against the face, there will be provided a gas-tight seal with additional comfort and adjustability available around the entire peripheral contacting portion of the headband and automatic adjustment by the pivoting elastic straps 45 and 56. Thus, the wearer can place the straps to suit above the ears, across the top of the head and thereby concentrate most of the pressure underneath the large chin area and reduce the pressure over the nose bridge or below the ears.

Thus it will be seen that in accordance

with the present invention there is provided a highly efficient respirator in which the face piece is so shaped and designed as to provide a cushion-like, readily collapsible contact with the face of the wearer, insuring a gas-tight fit over varying facial contours with amazing comfort; furthermore, there are provided inhalation valves which are of a construction so as to considerably reduce inhalation resistance and minimize voice distortion; also, there is provided a simple type of filter holder which facilitates replacement of filter cartridge units or filter units by turning the unit a mere  $1/4$  turn, which can be done while the respirator is being worn; also, there is provided an adjustable self-aligning headband for distributing pressure and avoiding concentration of the pressure along the nasal region of the face piece; all of which features considerably improve the efficiency of the respirator and its comfort in wear.

While we have illustrated and described several specific embodiments of our invention, it will be understood that these are by way of illustration only, and that various changes and modifications may be made within the contemplation of our invention and within the scope of the following claims.

Having now fully described and ascertained our said invention and the manner in which it is to be performed, we declare that what we claim is:—

1. A respirator including a self-adjusting face piece of resilient material and of substantially cup-shape, said face piece having a convex top portion, concave side nose portions, a substantially pear-shaped contour along its mouth portion and having an integral inwardly turned marginal edge portion extending from said mouth portion, said marginal edge portion being substantially thinner than the adjoining portion of the face piece and extending substantially along a plane to provide a gas-tight fit either when the face piece is worn high or low on the nose of the wearer.

2. A respirator according to claim 1, including the face piece of molded elastic material having the inwardly turned mar-

ginal edge portion extending from the mouth portion which is adapted to fit against the face of the wearer in gas excluding contact relationship, the thickness of said inwardly turned marginal edge portion being at least one-half of that of the immediately adjoining portion of the face piece so as to provide readily collapsible cushion-like engagement with the face of the wearer, the upper portion of said marginal edge portion being adapted to fit about the nose of the wearer and being disposed along a flat plane to permit wearing either high or low on the nose of the wearer.

3. A respirator according to claim 2 including the marginal edge portion extending outwardly from said mouth of the face piece of the order of  $3/16$  inch and has a thickness of the order of .025 inch around the nasal engaging portion, which thickness changes abruptly at the mouth portion, increasing to double the thickness along the side walls of the face piece and progressively increasing to a greater thickness along the front portion of the face piece.

4. A respirator according to claim 2 including filter holders of shallow cup-shape secured by grommets to the lower lobes of the face piece defining air inlet ports, said holders provided at their mouth with radially inwardly extending flanges and having annular gaskets supported therein along the periphery thereof, said respirator also including filter units having radially outwardly extending flanges extending from their bases, said flanges having inclined edges adapted to cooperate with said radially inwardly extending flanges for providing gas-tight engagement between the filter units and said gasket.

5. A respirator according to claim 4 including the filter holders provided with peripheral seat forming ledges at their marginal portions for supporting the gaskets and wherein each of the radially inwardly extending flanges of said filter units comprises an inclined plane portion, an adjoining intermediate portion of constant thickness and terminating at the other end in an upwardly projecting stop portion which is adapted to be arrested by

said inwardly extending flanges of said filter holders as the filter units are rotated for effecting a gas-tight seal between the units and holders.

6. A respirator according to claim 1 including a face piece having an air inlet aperture defined by a grommet, a thin flexible, substantially elliptical-shaped inlet valve secured near the edge portions of its major axis to the inside of said face piece and adapted to lie flat against the inner portion of the grommet to form an air excluding seal therewith and minimize voice distortion.

7. A respirator according to claim 5 including a pair of said filter holders secured to the face piece, snap studs formed on the backs of said cups, and a self-aligning headband comprising two halves detachably connected together, each half including a buckle, a Y-shaped elastic band slipped through said buckle and terminating in snap buttons for attachment to a pair of said snap studs, and each half having a single flexible strap slipped through the other portion of said buckle and terminating in a connector secured to a corresponding connector at the other end of the single strap of the one half.

8. A respirator according to claims 6

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and 7 including a face piece having an air inlet aperture, each of said shallow cup-shaped filter holders has a hole at the bottom thereof which is in registry with said inlet aperture and help thereagainst by a grommet, said filter holder having an an-supporting ledge, an annular gasket supported on said ledge, a plurality of integral, radially inwardly extending flanges projecting from the mouth portion of said holder, and a filter unit comprising a substantially cylindrical cover portion having a plurality of radially outwardly extending flanges projecting from the base thereof, each of said flanges having an end portion in the form of an inclined plane, an intermediate portion of constant thickness and the other end portion having formed thereon an upstanding stop for engagement against said inwardly extending flanges when said filter unit is rotated with its flanges inwardly of said filter holder.

Dated this 21st day of November, 1951.

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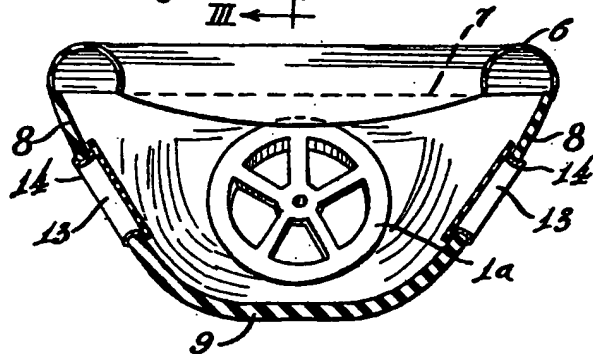
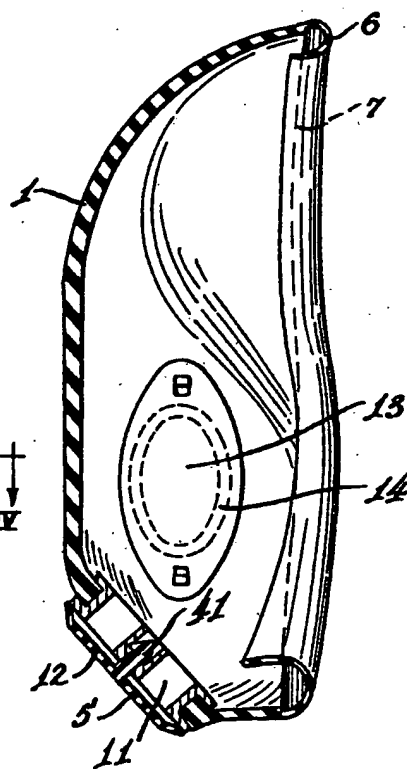
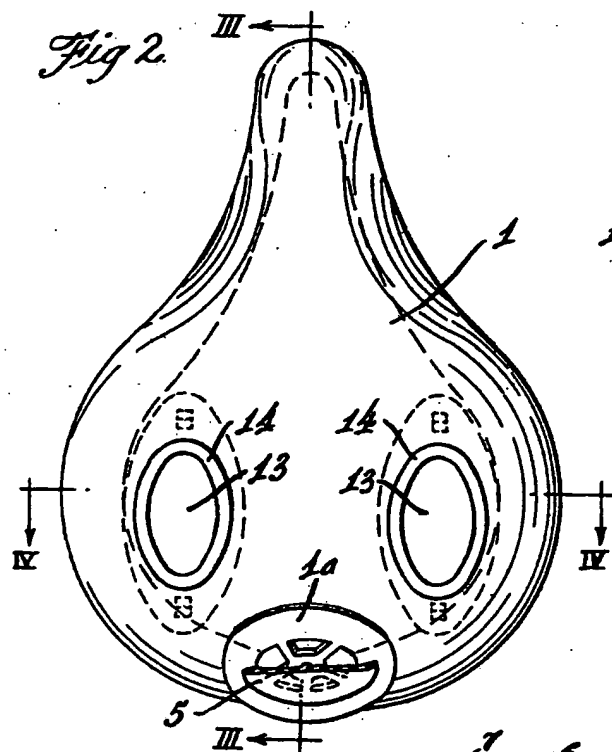
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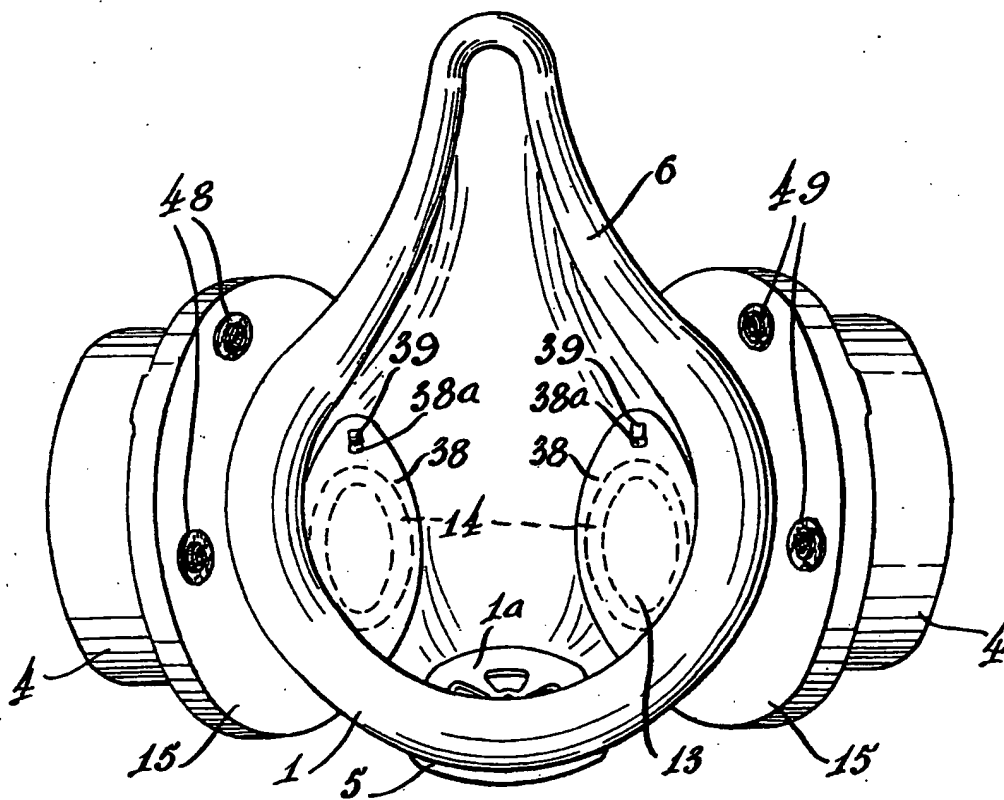
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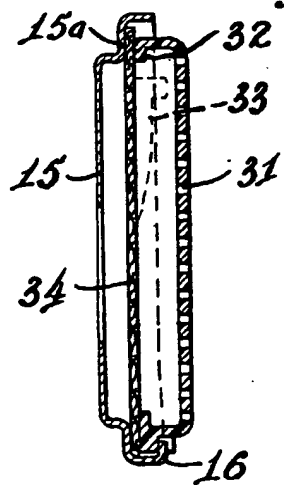




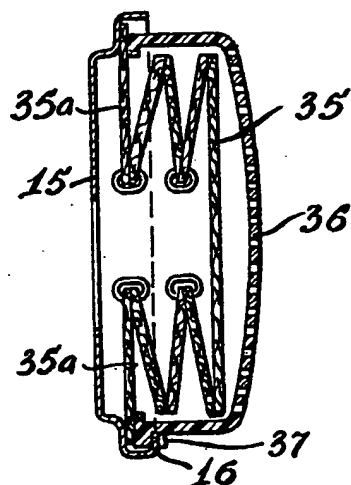




*Fig. 8.*



*Fig. 6.*



*Fig. 7.*

